GPCP SG V3.1 Release Notes

George J. Huffman*,[1], David T. Bolvin[1,2], Eric J. Nelkin[1,2], Robert F. Adler[3], Ali Behrangi[4], Guojun Gu[3], Jiang Jiang Wang[3], Yang Song[4]

1: NASA Goddard Space Flight Center
2: Science Systems and Applications, Inc.
3: Univ. of Maryland, College Park
4: Univ. of Arizona
*: george.j.huffman@nasa.gov

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Changes from Version 2 to Version 3

The algorithm for the Global Precipitation Climatology Project (GPCP) is being upgraded from Version 2 to Version 3 under projects funded by the NASA Making Earth Science Data Records for Use in Research Environments (MEaSUREs) program. Major changes in the Satellite-Gauge (SG) monthly product include:

- Upgrade geosynchronous infrared (GEO-IR) brightness temperature datasets, including expansion from the latitude band 40°N-S to 60°N-S, and shifting to a consistent-format record through the entire record. The latter required shifting the start-of-record date from January 1979 to January 1983.
- Upgrade algorithms for passive microwave (PMW) data (still only used for month-to-month calibration) and GEO-IR data.
- Shift from 2.5° to 0.5° lat./long. gridding.
- Add calibration by climatologies based on shorter-record, advanced sensors, including CloudSat, Global Precipitation Measurement (GPM) mission, and Tropical Rainfall Measuring Mission (TRMM).

Because the GPCP datasets are heavily used in the global research and application communities, we recognize that the significant changes that Version 3 entails require careful characterization before users can be expected to shift away from Version 2. As such, we consider the Version 2.3 to be the dataset of record for general use while Version 3.1 is examined, and likely upgraded in response to these studies.

Several figures and tables are included below showing the climatological differences between Versions 2.3 and 3.1. A complete description of V3.1 and detailed comparisons with V2.3 will be included in Huffman et al. (2020).

Changes from Version 3.0 (beta) to Version 3.1

Within Version 3, the monthly Satellite-Gauge product has now been upgraded to Version 3.1, and the previous Version 3.0 (beta) is considered obsolete. Major changes include:

- Use IR-only Advanced Infrared Sounder (AIRS-IR) estimates throughout, replacing the heterogeneous AIRS-microwave (AIRS-MW) / AIRS-IR record.

- Scale all Television InfraRed Operational Satellite (TIROS) Operational Vertical Sounder (TOVS) and AIRS-IR monthly estimates by the Merged CloudSat, TRMM, and GPM (MCTG) climatology products from 40°–90°N/S.
- Apply two separate calibrations of TOVS to AIRS-IR that were developed to account for the recent discovery in the original TOVS data set of a sharp decrease in frequency of precipitation for Ocean in the 70°-90°N latitude band beginning in December 1999:
  1. Calibrate the pre-December 1999 period on a calendar month basis, using independent 13+ year training data sets from TOVS and from AIRS-IR.
  2. Continue to apply the daily calibration of TOVS to AIRS developed in V3.0-beta to the period December 1999-August 2002, but now using AIRS-IR.
- Adjust GPROF-adjusted PERSIANN-CDR by blended Tropical Combined Climatology (TCC) / MCTG over the latitude band 60°N-S.
- Add two new fields to the output file:
  1. Gauge Relative Weighting, and
  2. Quality Index (QI).
- Extend the period of record through December 2019.

Access Information
Data are available from the Goddard Earth Sciences Data and Information Services Center (GES DISC) at *https://disc.gsfc.nasa.gov*. The complete naming convention can be found in the GPCPV3.1 README. Downloading data from GES DISC requires an Earthdata account, for which registration is free and easy (see *https://disc.gsfc.nasa.gov/data-access*).

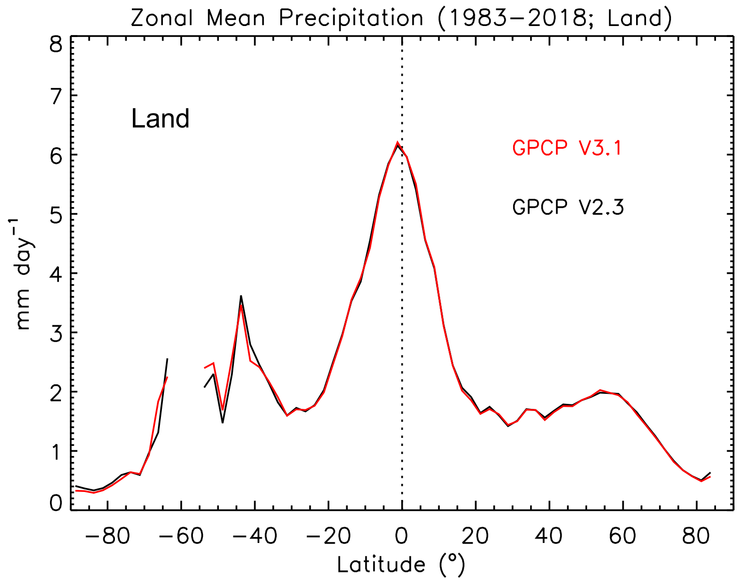
Additional Notes
In the future, GPCP expects to release upgrades to the monthly SG product, and to develop and release (globally complete) Version 3 daily and 3-hourly products.

Key GPCPV3.1 Documents
Algorithm Theoretical Basis Document
  https://docserver.gesdisc.eosdis.nasa.gov/public/project/MEaSUREs/GPCP/GPCP_ATBD_V3.1.pdf

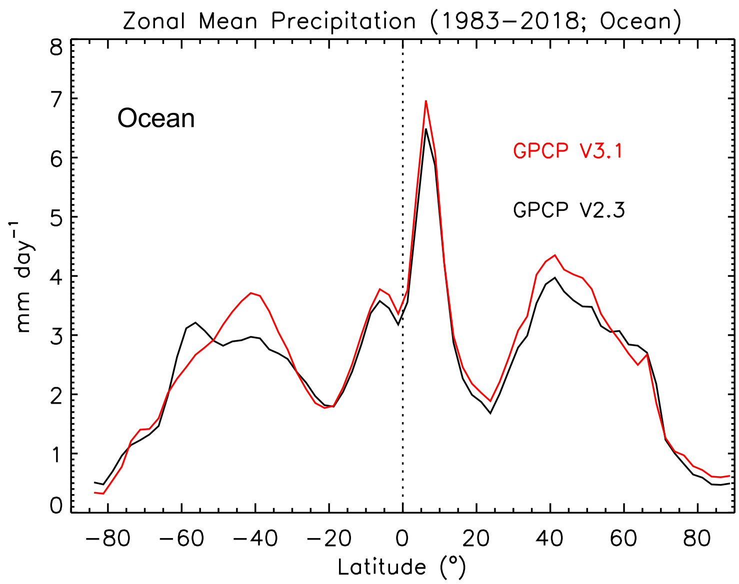
README
  https://measures.gesdisc.eosdis.nasa.gov/data/GPCP/GPCPMON.3.1/doc/README.GPCPV3.1.pdf

Journal manuscript
  Huffman, G.J., A. Behrangi, R.F. Adler, D.T. Bolvin, E.J. Nelkin, G. Gu, J.J. Wang, Y. Song, 2020: Introduction to the New Version 3 GPCP Monthly Global Precipitation Analysis, in preparation.

First Validation Results

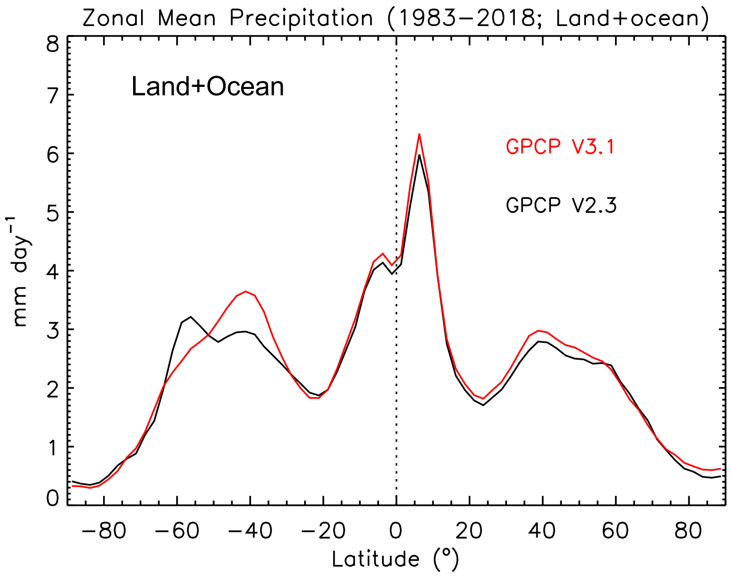


Land	V3.1 (mm/d)	V2.3 (mm/d)	Diff. (%)
25°N-S	3.46	3.48	-0.57
60°N-S	2.54	2.55	-0.39
90°N-S	2.23	2.24	-0.45



Ocean	V3.1 (mm/d)	V2.3 (mm/d)	Diff. (%)
25°N-S	3.32	3.16	5.06
60°N-S	3.25	3.04	6.91
90°N-S	3.08	2.90	6.21

Fig. 1. Zonal profiles of mean GPCP SG precipitation for 1983-2018 based on V2.3 (black) and V3.1 (red) for Land (top), Ocean (bottom), and Land+Ocean (following page), together with tables of mean values (mm/d) and difference (%). [G. Gu, U. Md./ESSIC] Both V2.3 and V3.1 use the same gauge combination scheme over Land, and gauges tend to dominate the Land results. Differences are mostly due to upgrades in the GPCC analysis and to approximations related to the finer 0.5° spatial scale for V3.1. See Fig. 5 for commentary on the differences over Ocean.



Land + Ocean	V3.1 (mm/d)	V2.3 (mm/d)	Diff. (%)
25°N-S	3.36	3.25	3.38
60°N-S	3.04	2.90	4.83
90°N-S	2.81	2.69	4.46

Fig. 1. Continued.

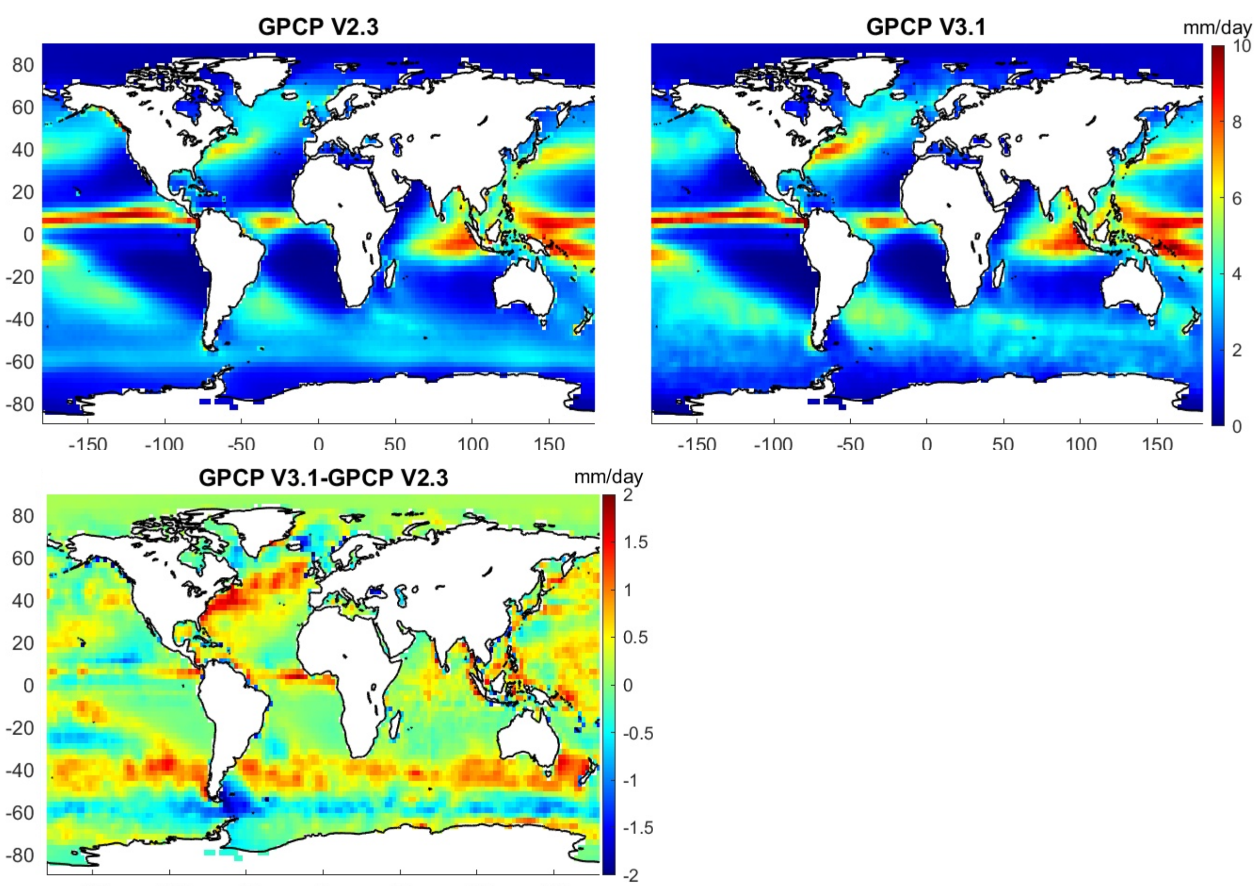


Fig. 2. Maps of mean GPCP SG precipitation for 1983-2018 based on V2.3 (top left) and V3.1 (top right), and the difference (bottom left) at 2.5° resolution in mm/d. [Y. Song, U. Az.]

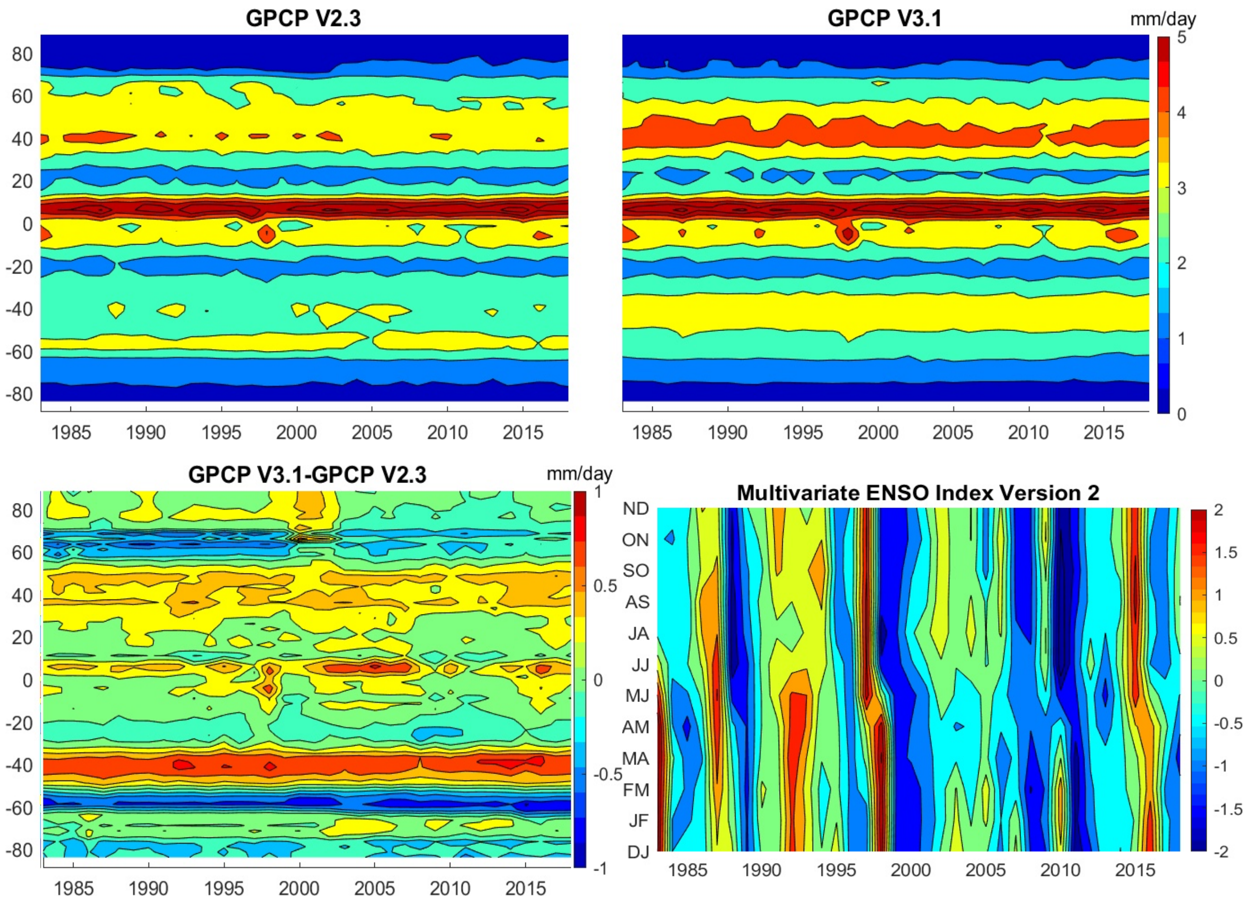


Fig. 3. Hovmöller diagrams of zonal-average Ocean-only monthly GPCP SG precipitation for 1983-2018 based on V2.3 (top left) and V3.1 (top right), and the difference (bottom left) at 2.5° resolution in mm/d. The Multivariate El Niño/Southern Oscillation (ENSO) Index, Version 2 (lower right), is shown to help interpret ENSO variations in the records, with bimonthly smoothed values plotted as columns for each year, with position in the year increasing upwards. [Y. Song, U.Az.] To zero order, the precipitation is relatively constant as a function of time, although near the equator there is a positive correlation of Multivariate El Niño Southern Oscillation (ENSO) index (MEI) with precipitation in both V2.3 and 3.1.

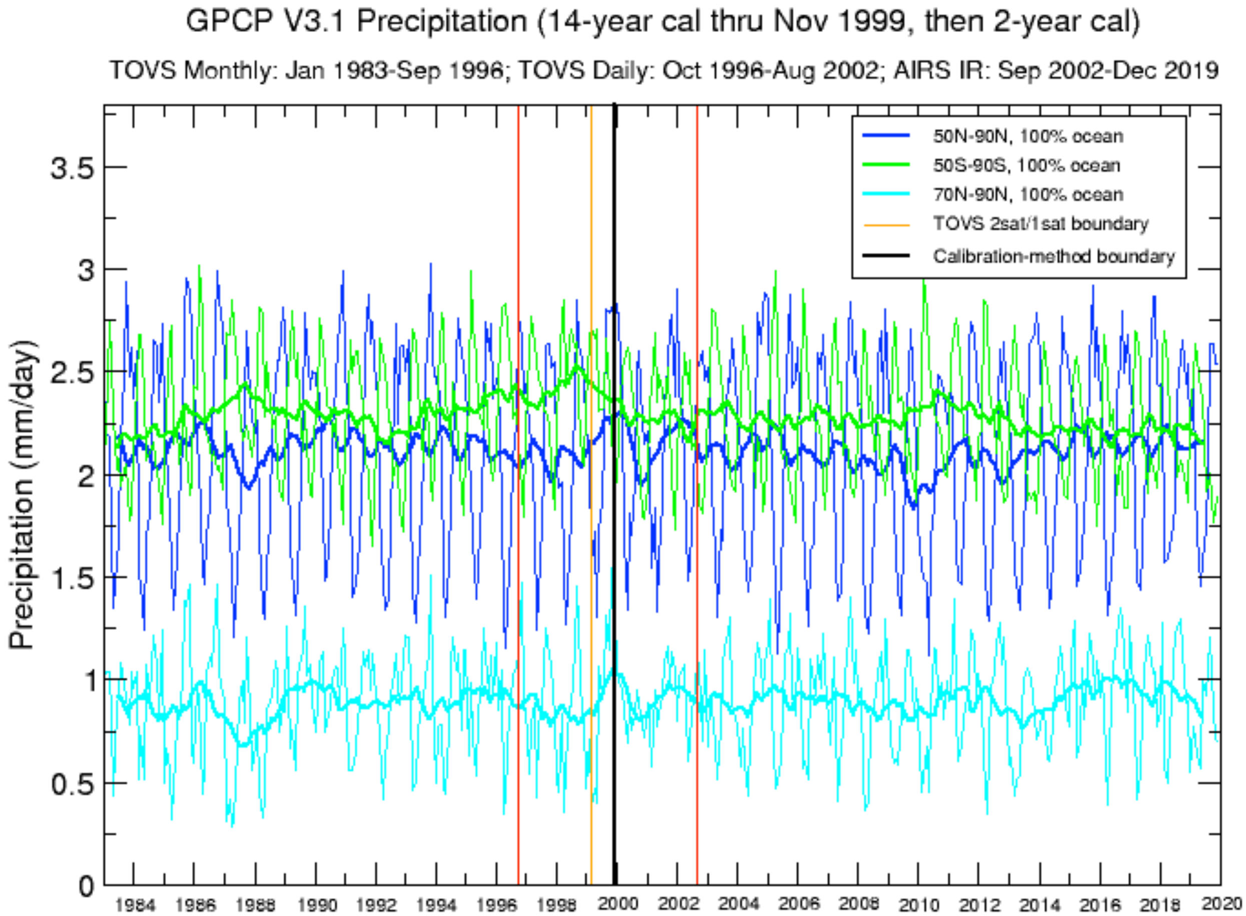


Fig. 4. Time series of GPCP SG V3.1 for various high-latitude zones, with vertical lines marking three internal data boundaries identified in the TOVS/AIRS record. Light lines are the monthly record, while heavy lines are smoothed with a running 13-month boxcar filter. Despite the relatively success of using these data in V2 products, achieving a calibration across the TOVS/AIRS-IR record with good continuity was a significant challenge to creating V3.1. In part, this is because V3.1 takes the AIRS-IR record as the base product, while the V2 products had taken the TOVS record as the base product..

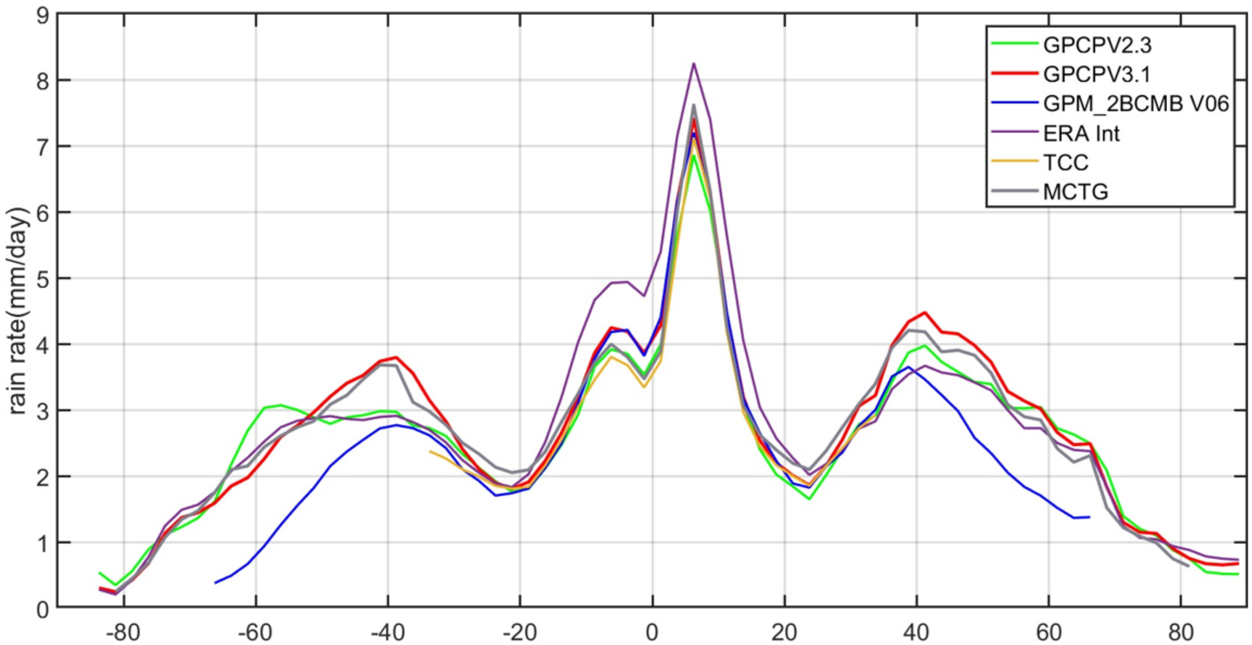


Fig. 5. Ocean-only zonal profiles of V2.3, V3.1, the GPM Combined Radar/Radiometer Algorithm (GPM DPRGMI), and European Centre for Medium-range Weather Forecasting (ECMWF) Reanalysis - Interim (ERA Int) averaged over 2015-16. As well, the zonal profiles of the annually averaged TCC and MCTG are plotted. [Y. Song, U. Az.] V3.1 roughly follows its calibrators in their respective domains, namely 25°N-S for TCC and 35-90°N,S for MCTG. Exact matches should not be expected because the climatologies are drawn from years other than 2015-16. The consistency with the calibrators explains the local maxima in V3.1 around 40°N,S, which are higher than V2.3, and the lack of a maximum near 60°S that V2.3 exhibits. V3.1 rolls over from TCC to MCTG calibration in the intervening latitude bands 25-35°N,S. GPM DPRGMI is close to the TCC, as expected, and displays increasingly negative bias outside 40°N,S, which is consistent with other studies.